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TERGAL AND STERNAL ANOMALIES IN *NEOBISIUM* CHAMBERLIN (NEOBISIIDAE, PSEUDOSCORPIONES, ARACHNIDA)[1]

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ABSTRACT

Traumatic (teratological and accidental) variation in the structure of the abdominal sclerites has been studied in the pseudoscorpion species *Neobisium carpaticum* Beier 1934, and *N. fuscimanum* (C. L. Koch 1843). In the former species, tergal abnormalities have been found in 0.75 - 1.33% of the samples analyzed; in the latter, tergal and sternal deficiencies have been noted in 0.97% of the sample studied. The following aberrations have been observed: hemiatrophy, hemimery, symphysomery, and enlargement of the sclerites, as well as various combinations of these anomalies. The pathomorphology and possible origin of these teratological phenomena are discussed.

INTRODUCTION

Within the pseudoscorpion family Neobisiidae, anomalies of abdominal tergites and sternites have been registered to date for the following species: *Neobisium erythrodactylum* (L. Koch 1873), *N. maritimum* (Leach 1817), *N. muscorum* (Leach 1817), *N. carpaticum* Beier, 1934, *N. sylvaticum* (C. L. Koch 1835), and *Roncus lubricus* L. Koch, 1873 (Pedder 1965; Ćurčić 1980; Ćurčić et al., in press).

In this paper, we aim firstly to express qualitatively and quantitatively the phenomenon of traumatic (teratological and accidental) variation in the structure of the abdominal sclerites in the species *N. carpaticum* and *N. fuscimanum* (C. L. Koch 1843), especially in the adult stage (males and females) in order to assess the frequency and origin of such aberrations.

MATERIALS AND METHODS

A total of 1,550 adult specimens of *N. carpaticum* from Mt. Avala, near Belgrade (1,000 specimens, 500 of each sex), Mt. Fruška Gora, near Sremski Karlovci (150 speci--mens, 75 of each sex), and Mt. Kosmaj, near Mladenovac, Yugoslavia (400 specimens, 200 of each sex) were collected. In addition, 310 specimens (155 of each sex) of *N. fuscimanum* from Mt. Avala, near Belgrade were examined.

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Specimens of *N. carpaticum* were collected by sieving leaf-litter of mixed oak and beach forest while specimens of *N. fuscimanum* were taken from leaf-litter of an oak forest within the period extending from September 1972 to May 1981.

The nomenclature of anomalies of the abdominal sclerites made by Balazuc (1948) was used in this paper.

RESULTS

A total of seventeen abnormal specimens were found – 14 of *N. carpaticum* and three of *N. fuscimanum*. The results of the analysis of teratological variability in the structure of the abdominal tergites and sternites of these two species are as follows:

Neobisium carpaticum

(a) Male (Fig. 1A). In this specimen, parts of tergite I and especially of tergite II are missing; there is no pigmentation in the affected area. As a consequence of this deficiency, we found a disturbance of the chaetotaxy of the first two abdominal tergites, manifested in the reduced number and unequal distribution of setae.

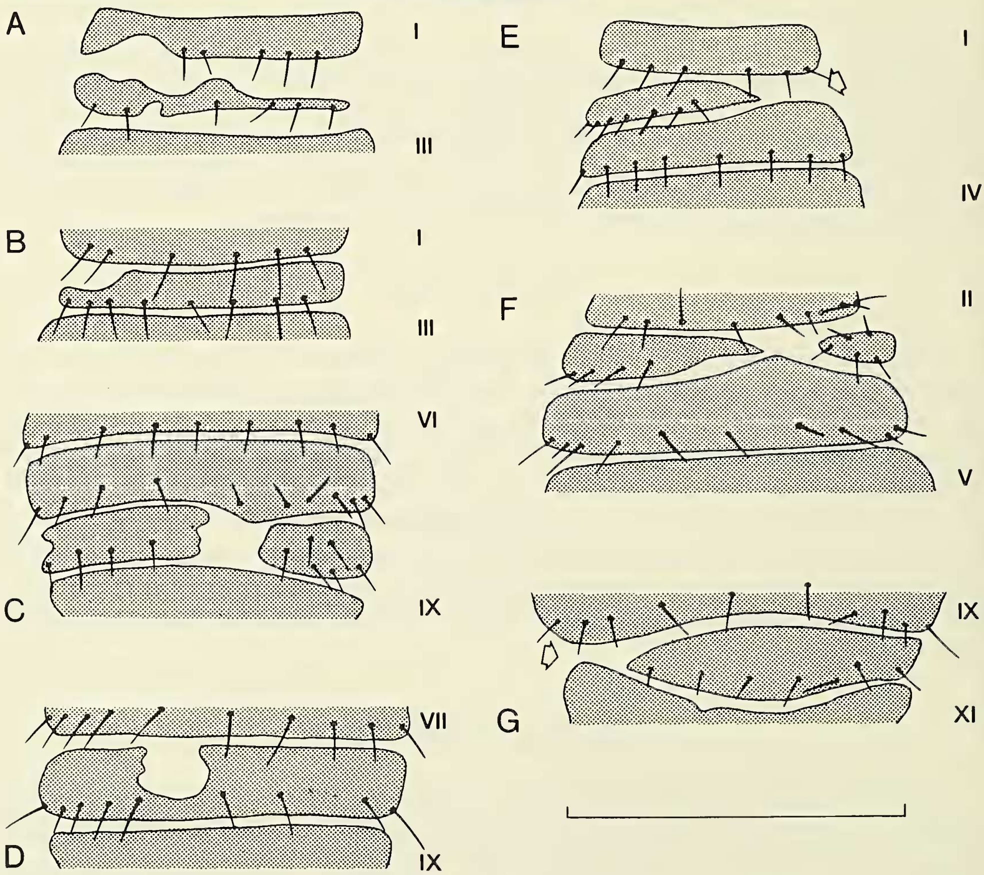

Fig. 1.–*Neobisium carpaticum* Beier 1934; scale bar = 1 mm. A, tergites I-III, male, Mt. Avala; B, tergites I-III, male, Mt. Avala; C, tergites VI-IX, female, Mt. Avala; D, tergites VII-IX, female, Mt. Avala; E, tergites I-IV, male, Mt. Avala; F, tergites II-V, male, Mt. Kosmaj; G, tergites IX-XI, female, Mt. Fruška Gora.

(b) Male (Fig. 1B). Part of the left side of tergite II is missing; this area lacks pigmentation. Despite this anomaly, the setal formula of tergite II is unaltered.

(c) Female (Fig. 1C). Tergites VII and VIII are anomalous which is more pronounced on the latter tergite. The mid-region of tergite VIII is completely absent. Although the numbers of setae on these two tergites are unchanged, their distributions deviate significantly from normal specimens - on the right side of tergite VIII, the setae are unequally distributed and are arranged in two rows. The mid-region lacks any setae. The central part of the tergite VII is enlarged backwards to fill part of the space left vacant in tergite VIII.

(d) Female (Fig. 1D). The left anterior part of tergite VIII is without pigmentation. Because of this anomaly, the setal formula of tergite VIII is altered, and the setae are concentrated on the left half of the sclerite.

(e) Male (Fig. 1E). In this specimen, the right half of tergite II is missing. The adjacent part of tergite III is enlarged and partially fills the gap left by the missing half of tergite II. The arrangement of setae on the damaged sclerite is altered, and the setae are concentrated on the left half of the tergite.

(f) Male (Fig. 1F). In this case, a deficiency is found in tergite III manifested by the absence of the mid-region of the sclerite. This anomaly has caused the unequal distribution of individual setae. On the right, the setae are concentrated on the small section of tergite III where they are arranged in two rows. Tergite IV is enlarged in its mid-region and fills the central space where the missing part of tergite III would otherwise be found.

(g) Female (fig. 1G). Part of tergite X on the left is missing, and thus tergite IX touches tergite XI directly in this region. In addition, the number of setae on the sclerite is reduced compared with the values which have been quoted for *N. carpaticum* (Ćurčić 1977).

(h) Male (Fig. 2A). Tergites III and IV are fused from the left side to the mid-region. Thus the relative distribution of the setae on tergite III is altered and does not correspond to that accepted for *N. carpaticum* (Ćurčić 1977).

(i) Male (Fig. 2B). In this case, tergite IV and V have partially fused both from the right side to the mid-region. The number of setae on tergite IV is reduced, and the setal distribution is unequal.

(j) Male (Fig. 2C). Tergites VI and VII are fused in the mid-region. Apart from this, there is a reduction in tergite VI which resulted in the existence of a small isolated tergal section on the right. The region in which fusion has taken place (tergite VI) as well as the mid-region of tergite VII are free of setae, and thus their number is lower than the values quoted elsewhere for *N. carpaticum* (Ćurčić 1977).

(k) Male (Fig. 2D). Tergites VI and VII of this specimen are also fused in the mid-region. The setal formula shows a reduction in the number of setae on both tergites, and the position of the setae are altered (the central tergal region lacks setae).

(l) Male (Fig. 2E). In this specimen, tergites VIII and IX are fused for almost their whole length, except for one part on the left side. As a consequence, the setae on tergite VIII are few in number and unequally distributed, as well as being completely lacking in the mid-region.

(m) Male (Fig. 3). In this case, the tergal abnormalities affect five tergites. The deficiencies on tergites II-V are manifested as follows: the left half of tergite II and III are missing, with two small irregularly-shaped tergal sections on the damaged side. The consequence of this anomaly is that tergite IV is enlarged in its left part. There is a direct correlation between changes in the segmentation of the abdominal tergites II and III and changes in their chaetotaxy; these are manifested primarily in the reduced number of setae and in their unequal distribution compared with the normal situation in *N. carpaticum.*

Another interesting anomaly in the same specimen is found in tergite VII and VIII. First of all, the mid-region of tergite VII is missing: this region has no pigmentation. Besides this, tergites VII and VIII are fused in the mid-region. As a result of this anomaly, the number of setae in the mid-region of the tergite VII is reduced, whereas the distribution of the setae is altered compared with the values quoted elsewhere for *N. carpaticum* (Ćurčić 1977).

(n) Male (Fig. 4). The posterior tergites of this specimen (IX-XI) are partially fused on the left (Fig. 4A). This deficiency has caused a disturbance in the distribution of setae on tergites IX and X, and on tergite X, the total number of setae is less than in normal specimens.

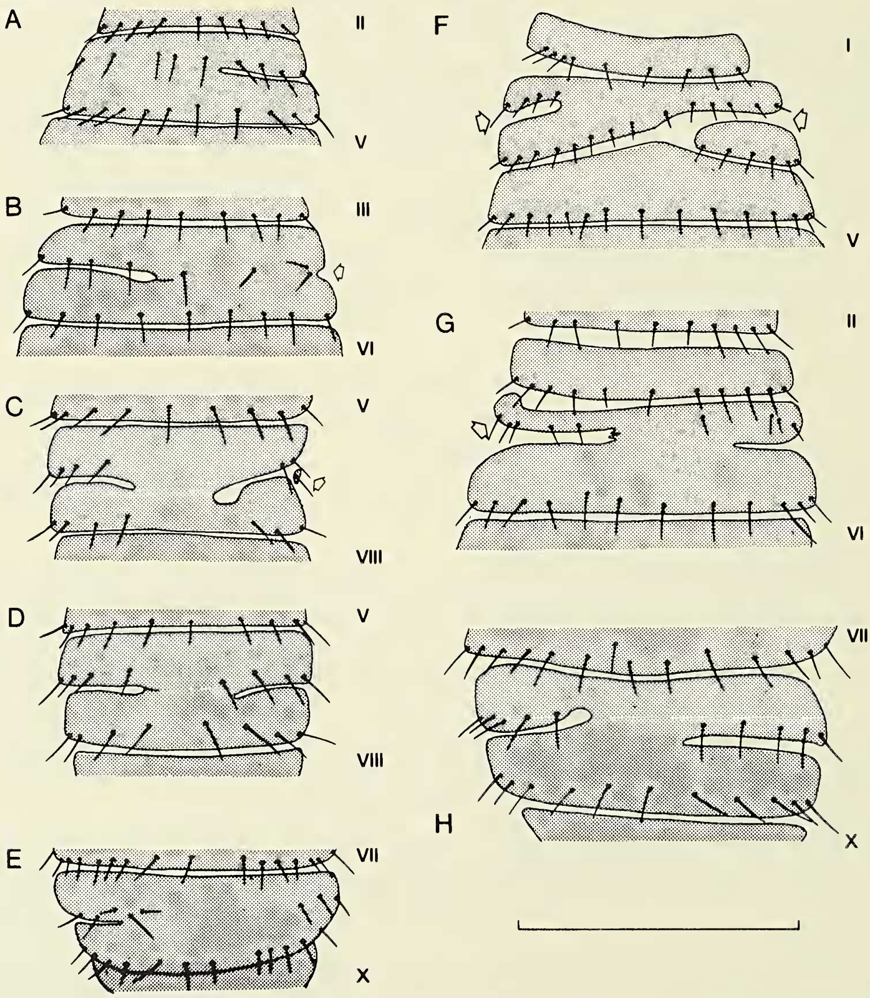

Fig. 2.–*Neobisium carpaticum* Beier 1934 (A-E) and *N. fuscimanum* (C. L. Koch 1843) (F-H); scale bar = 1 mm. A, tergites II-V, male, Mt. Fruška Gora; B, tergites III-VI, male, Mt. Avala; C, tergites V-VIII, males, Mt. Avala; D, tergites V-VIII, male, Mt. Avala; E, tergites VII-X, male, Mt. Avala; F, tergites I-V, males, Mt. Avala; G, tergites II-VI, male, Mt. Avala; H, tergites VII-X, male, Mt. Avala.

In the same pseudoscorpion there are similar changes on the ventral part of the abdomen (Fig. 4B). In this case, sternites IX and X are fused on the left side. It is obvious, however, that sternite X is narrowed on the left side which is otherwise linked with the previous sclerite. This abnormality has not caused corresponding alternations in the setal formula of the sternites.

Neobisium fuscimanum

(o) Male (Fig. 2F). It is interesting to note the teratological changes on tergites II-IV of this specimen. Thus tergites II and III are fused on the left, with the left half of tergite III fused with the mid-region of tergite II. Hence the right half of tergite III (right demi-tergite) is isolated and is not linked with the other part of the same tergite. Tergite IV is enlarged and fills the region between left and right demi-tergite III.

As a result of these changes, the chaetotaxy of tergites II and III is altered, particularly in relation to the number and relative arrangement of the setae.

(p) Male (Fig. 2G). Tergites IV and V are deficient. Tergite IV is significantly narrowed and is joined in its mid-region with tergite V. The consequence of this anomaly is seen in the irregular chaetotaxy of tergite IV; that is, in the lower number of setae and their altered distribution.

(q) Male (Fig. 2H). Tergites VIII and X are fused in the mid-region. This teratological phenomenon has resulted in this region of tergite VIII being deprived of setae.

DISCUSSION

In the specimens of *N. carpaticum* studied, tergal abnormalities were found in 0.75% of the cases in the sample from Mt. Kosmaj, in 0.90% of the cases in the sample from Mt. Avala, and in 1.33% of the cases in Mt. Fruška Gora sample. The absence of any tergal and sternal abnormalities in the subadult stages (Ćurčić et al., 1981) shows that these anomalies originate during the maturation molt; that is, at the transformation of tritonymph into adults.

Of a total of fourteen specimens of this species with tergal and sternal anomalies, twelve specimens (or 86%) are males and only two are females (14%). It is clear from earlier studies (Ćurčić and Dimitrijević, in press) that various tergal and sternal deficiencies in *N. carpaticum* occur mainly at the maturation molt of tritonymphs into males; the results of the present analysis support the above opinion, since the majority of abdominal anomalies occur in the male. The reason for this phenomenon is still unclear.

Tergal and sternal anomalies in *N. fuscimanum* were found in three specimens or 0.97% of the sample from Mt. Avala. As in the preceding species, the abnormalities of the abdominal sclerites are restricted to males. It remains to be confirmed on the basis of analysis of a larger number of examples among species from different locations whether the (male) sex-linked nature of the origin of the abdominal anomalies is characteristic only of certain taxa of pseudoscorpions, or whether it is universally valid for representatives of the Neobisiidae and other families.

In *N. carpaticum* (Fig. 1A), atrophy of sections of tergites II and III were discovered; this anomaly resulted in disruption of the number and distribution of setae of both tergites. Partial atrophy of tergite II was also found in the following case (Fig. 1B), but the tergal chaetotaxy was not changed. In another example of the same species (Fig. 1C), the tergal anomaly can also be characterized as partial atrophy of tergite VIII, in which the mid-region of this sclerite is missing. The chaetotaxy of the right section of the same tergite is significantly disturbed. Apart from this, the preceding tergite is enlarged in its mid-region and partially fills the space left by the missing part of tergite VIII. A similar phenomenon is also noted in the following specimen (Fig. 1D).

Apart from tergal atrophy, the defective specimens (Fig. 1E-G) are also characterized by the presence of hemimery (or partial atrophy ?) of a tergite and enlargement of an adjacent tergite that partially fills the space left by the missing part of the damaged tergite. In all three cases quoted (Figs. 1E-G), as a result of the anomalies, the chaetotaxy of affected tergites is disturbed and does not correspond to that recorded for normal *N. carpaticum* (Ćurčić 1977).

In *N. carpaticum*, symphysomery has been discovered, in which two adjacent tergites were fused in the middle (Figs. 2C and 2D), on the left (Fig. 2A), or on the right side (Figs. 2B and 2E). In all of these specimens, the setal formula of the specimen of *N. carpaticum* (Fig. 2C), partial atrophy of the sclerite was found in addition to the symphysomery which affected tergites VI and VII.

Considerably more complex damage was found in the male of the same species from Mt. Fruška Gora (Fig. 3). In this case, deficiencies were observed in as many as five tergites; they include hemimery, partial atrophy, and symphysomery as well as enlargement of part of the sclerite (left demi-tergite IV).

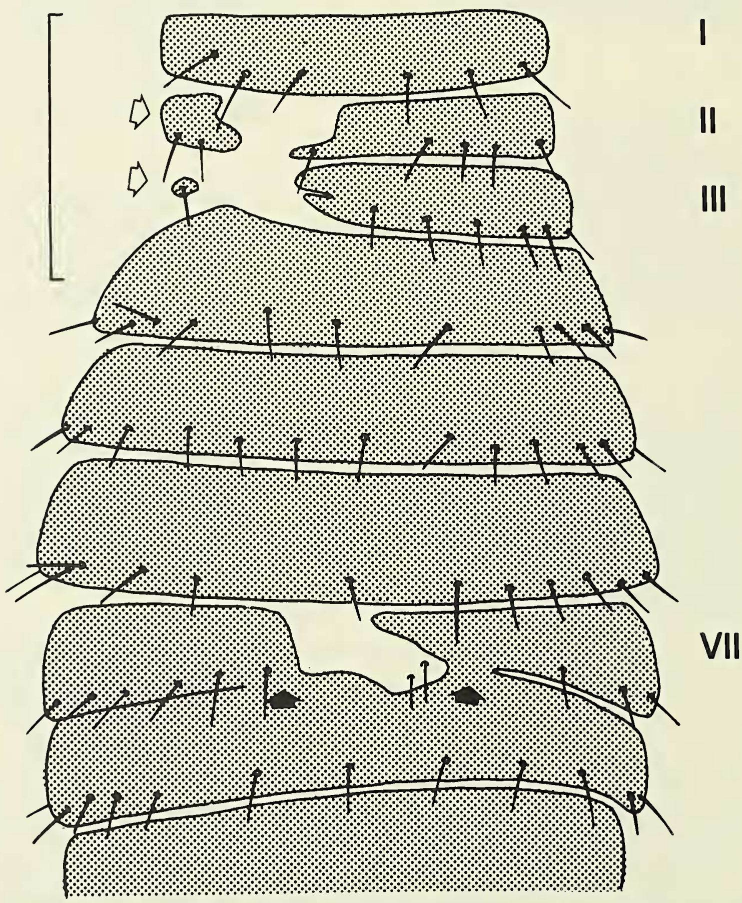

Fig. 3.—*Neobisium carpaticum* Beier 1934, male, Mt. Fruška Gora; scale bar = 0,5 mm. Tergites I-X.

The only case of anomaly in the structure of the sternites (symphysomery) was recorded in a male of *N. carpaticum* from Mt. Kosmaj (Fig. 4B). This abnormality is correlated with the phenomenon of symphysomery of tergites IX-XI of the same specimen (Fig. 4A). In this pseudoscorpion, the setal formula of the damaged tergites were considerably disturbed, but not of the sternites.

In *N. fuscimanum*, cases of symphysomery and combinations of symphysomery and partial atrophy and of symphysomery and helicomery were noted. In the first case (Fig. 2H), the tergites were fused in the mid-region, as was the case with the second specimen (Fig. 2G), where the anterior fused sclerite was also partially atrophied. In the third case (Fig. 2F), the tergites were partially fused on the left, with the right half of one tergite fusing with the left half of the adjacent tergite (dextral monocyclical helicomery). In addition, the anteromedian part of the adjacent tergite IV was enlarged. In all of these instances, the chaetotaxy of the tergites differs from that of normal specimens (Ćurčić 1977).

Analysis of teratological variability has shown that in *N. carpaticum* and *N. fuscimanum* the phenomenon of symphysomery is manifested on tergites III-X, with maxi-

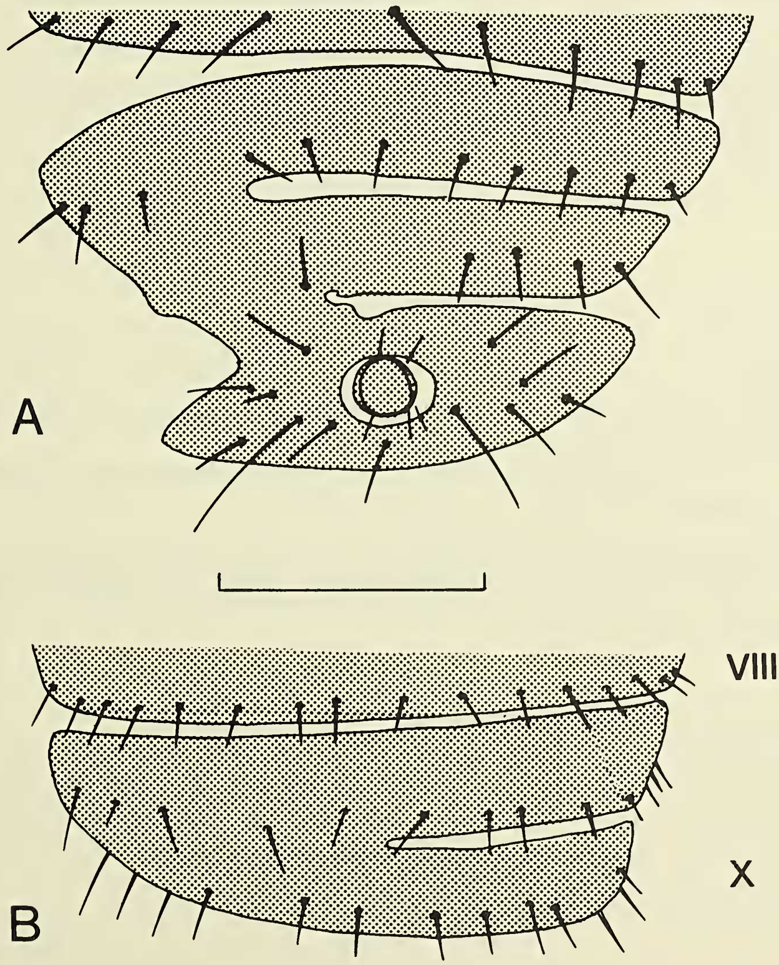

Fig. 4.–*Neobisium carpaticum* Beier 1934, male, Mt. Kosmaj; scale bar = 0,5 mm. A, tergites VIII-XIII; B, sternites VIII-X.

mum frequency on tergites IV and VII-X. Hemiatrophy and hemimery, however, affect the anterior (I-III) and posterior tergites (VII-X), which corresponds with the conclusion drawn by Ćurčić and Dimitrijević (in press). The maximum frequency of three phenomena is found in tergite II. Helicomery occurs most rarely of all and was found in only one case and on tergites II and III. Sternal aberration (symphysomery) was also observed in a single specimen of *N. carpaticum*, affecting sternites IX and X.

In *N. fuscimanum*, three cases of symphysomery were registered, two of these in combination with helicomery and partial atrophy, whereas the occurrence of other types of tergal anomalies was not established.

The majority of abnormalities observed in the tergal and sternal structures of the pseudoscorpions *N. carpaticum* and *N. fuscimanum* are the result of changes which probably took place at the last molt. A small number of the anomalies seen, however, could have arisen as the result of mechanical damage to the tergites at one of the earlier developmental stages.

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